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(54) **Aerial for Body-worn Radio Apparatus**

(57) An aerial system for bodyworn radio apparatus such as a transceiver comprises a first conductor 3 attached to or incorporated in a strap 2 of a carrying harness arranged to pass over the shoulder of the wearer, and a second conductor 4 suspended from the harness or transceiver. The first conductor is connected to the earthy side of the aerial input of the transceiver and acts as an electrical counterpoise for the second conductor which is connected to the live side of the aerial input.

The second conductor may have an electrical length of a quarter of the wavelength to which the transceiver is tuned and to provide a compact construction may be helically wound.

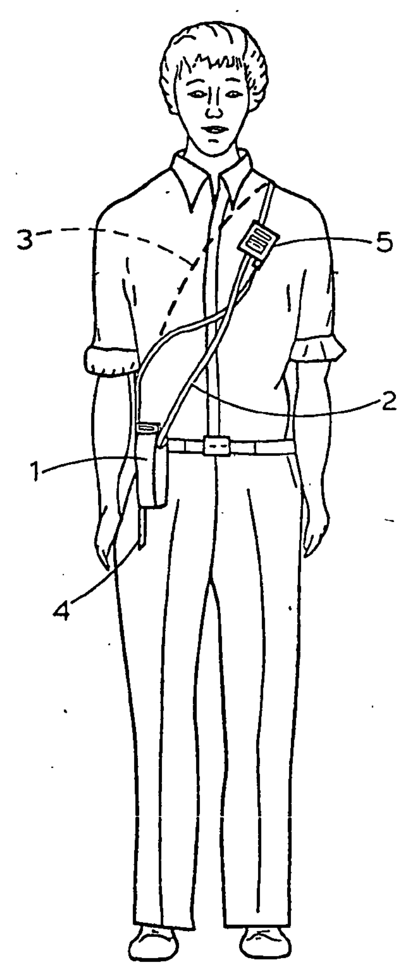

Fig.1

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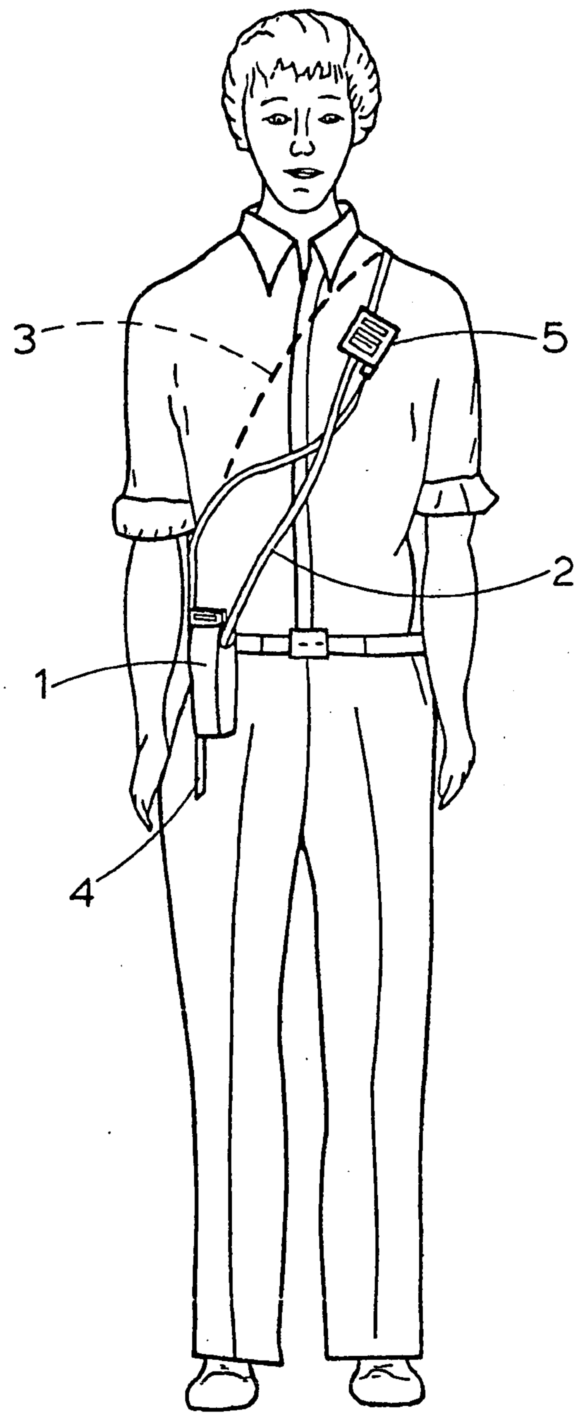

Fig.1

Fig. 2a

Fig. 2b

Fig. 2c

Fig. 2d

Fig. 2e

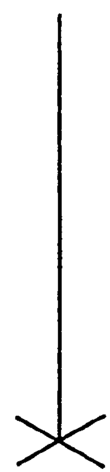

Fig. 2f

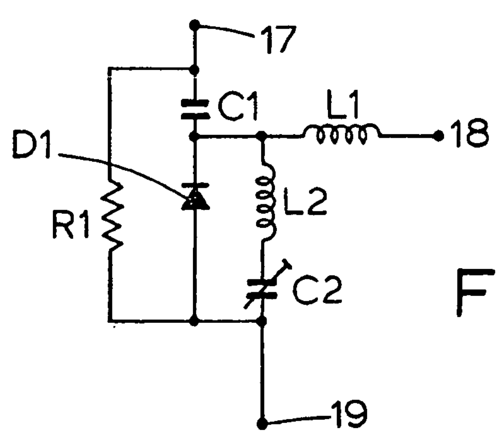

Fig. 6

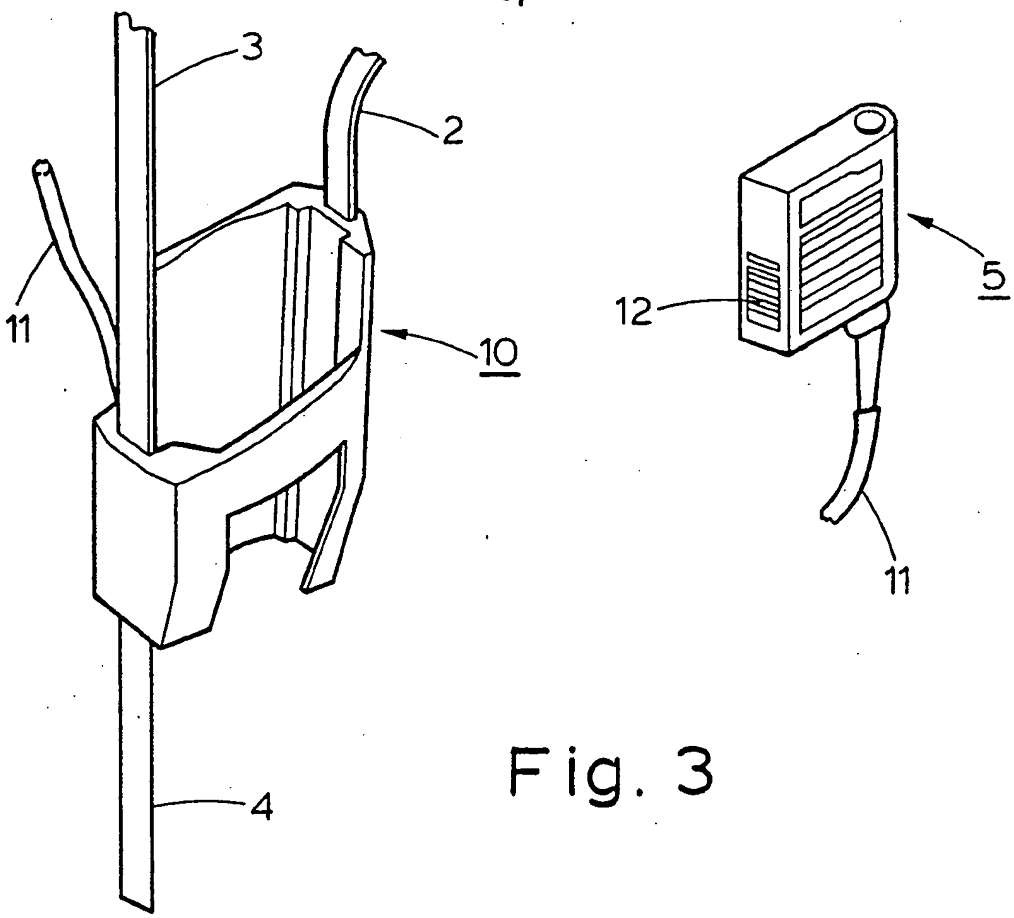

Fig. 3

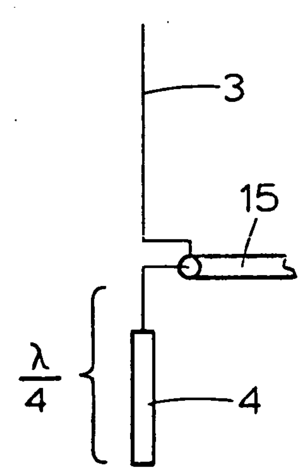

Fig. 4

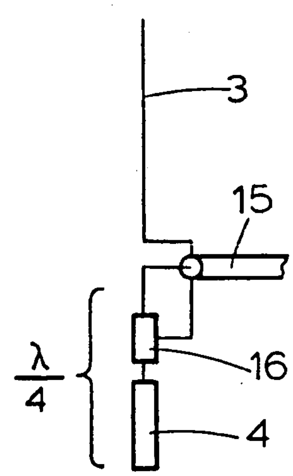

Fig. 5

SPECIFICATION

Aerial System for Bodyworn Radio Apparatus

The invention relates to an aerial system for bodyworn radio apparatus comprising a harness for carrying the radio apparatus, a first conductor attached to or incorporated in a strap of the harness arranged to pass over the shoulder of the wearer, a second conductor suspended from the harness or radio apparatus and means for connecting one end of each of the conductors to an aerial input of the radio apparatus.

Portable radio transceivers may for convenience be worn at the hip of the user and may be carried on a harness which comprises a strap which extends over the shoulder of the user. A known aerial system for such a transceiver comprises a first conductor attached to or embedded in the strap and connected to the live side of the aerial input of the transceiver and an electrical counterpoise in the form of a length of wire which is suspended from the transceiver and connected to the earthy side of the aerial input i.e. the side connected to the chassis or case of the transceiver. Thus if a co-axial feeder is used to connect the aerial system to the input and/or output of the transceiver the first conductor would be coupled to the inner conductor and the counterpoise of the screen of the co-axial cable. The length of the first conductor depends on the frequency of operation of the transceiver but is normally chosen to be approximately a quarter of the wavelength of the radio waves to which the transceiver is tuned. Such aerials suffer from the disadvantages that performance varies markedly with the position of the wearer due to body absorption and screening of the radio waves and marked changes in resonant frequency occur due to variations in capacitance to earth when the wearer moves or when clothing thickness is changed. The aerial has a significantly worse performance than a quarter wave whip aerial employed on a hand held transceiver.

It is an object of the invention to provide an aerial system for a bodyworn radio apparatus which is less influenced by the body position than the aerial discussed hereinbefore.

The invention provides an aerial system for bodyworn radio apparatus comprising a harness for carrying the radio apparatus, a first conductor attached to or incorporated in a strap of the harness arranged to pass over the shoulder of the wearer, a second conductor suspended from the harness or radio apparatus and means for connecting one end of each of the conductors to an aerial input of the radio apparatus characterised in that the second conductor is connected to the live side of the aerial input and the first conductor is connected to the earthy side of the aerial input. It has been found that by reversing the connection between the first and second conductors and the aerial input the effect of body capacitance and shielding is reduced, and that at 70 MHz the aerial system has approximately 7 db greater gain than the previously known configuration while at 170 MHz approximately 2 db greater gain is achieved. The second conductor may have an electrical length of a quarter of the wavelength of the signal to which the radio apparatus is tuned. To provide compact construction the second conductor may be helically wound.

Means may be provided for varying the resonant frequency of the aerial system. This enables the aerial to be tuned to a receive frequency which is different from a transmitted frequency. The means for varying the resonant frequency may comprise means for inserting a capacitive or inductance reactance between the second conductor and the aerial input of the radio apparatus.

Means may be provided for switching the inductive or capacitance reactance into or out of the aerial system, the switching being dependent on whether the apparatus is receiving or transmitting radio signals. The switching means may comprise means for generating a direct voltage and applying it via a transmission line from the radio apparatus to the means for inserting the reactance.

A holster may be attached to the harness, the radio apparatus being carried in the holster. The radio apparatus and holster may be provided with a co-operating plug and socket assembly to enable connection between the radio apparatus and the aerial.

Embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings, in which

Figure 1 shows an aerial system according to the invention worn on the body of the user,

Figure 2 shows schematically alternative forms for the pendant section of the aerial system,

Figure 3 is a perspective view of a holster for a transceiver, the holster being carried on a harness incorporating an aerial system according to the invention,

Figure 4 shows schematically the electrical circuit of the aerial system,

Figure 5 shows a modification of the aerial system enabling the resonant frequency of the aerial system to be varied, and

Figure 6 is a circuit diagram of the tuning circuit of Figure 5.

Figure 1 shows a bodyworn transceiver 1 carried on a harness comprising a shoulder strap 2. An aerial system comprising a conductor 3 carried by the shoulder strap 2 where it passes over the back of the wearer and a pendant section 4 is connected to the transceiver 1. A microphone/loudspeaker unit 5 may be clipped to the shoulder strap 2. The conductor 3 is connected to the earthy side of the transceiver, i.e. to the chassis or case, and forms an electrical counterpoise for the pendant section 4 which is connected to the live side of the transceiver and is arranged to have an electrical length of approximately a quarter of the wavelength of the signal to which the transceiver is tuned. For

convenience the pendant section 4 may be formed as a helically wound conductor which gives a relatively compact construction. However, depending on the operating frequencies of the transceiver other forms of aerial section could be used. Figure 2 shows some of the alternative forms which could be used. Figure 2(a) shows a straight conductor which may be flexible, Figure 2(b) shows a centre loaded conductor, Figure 2(c) shows a helically wound conductor, Figure 2(d) shows a bottom loaded conductor, Figure 2(e) shows a straight conductor plus a helically wound conductor, and Figure 2(f) shows a capacitance loaded conductor.

Figure 3 shows a holster 10 in which the transceiver may be mounted. The harness 2 is connected to the holster 10 together with a cable 11 which leads from the microphone/loudspeaker unit 5. The cable 11, conductor 3 which is formed within the strap forming the harness 2 and pendant section 4 are all connected to a terminal block (not shown) with which a co-operating terminal block on the transceiver 1 mates when the transceiver is inserted in the holster. The microphone/loudspeaker unit 5 includes a pushbutton switch 12 which is pressed to switch the transceiver to the transmit mode and released to switch the transceiver to the receive mode.

Tests have shown that the performance of the aerial system is less affected by changes due to body capacitance and shielding than the previously known system. By making the conductor in the harness, which is close to the body, the electrical counterpoise, the variations in capacitance between this conductor and the body of the wearer due to varying thickness of clothes do not have as large an effect on the performance of the aerial system. Therefore a more consistent performance is achieved. In addition in a serimes of tests on this aerial system it has been found that an increase of gain relative to the gain when the suspended conductor is the counterpoise of approximately 7 db can be achieved at 70 MHz and 2 db at 170 MHz.

Figure 4 shows the electrical circuit of the aerial, the conductor 3 being connected to the screen of a co-axial cable 15 for connection to the input/output of the receiver/transmitter. The pendant section is connected to the central conductor of the co-axial cable 15. Figure 5 shows a modification to enable the resonant frequency of the aerial system to be altered. The transceiver may be arranged to transmit at a different frequency from that which it is tuned to receive, in which case the aerial has to be tuned to a frequency which is chosen as a compromise between the transmit and receive frequencies or the tuning has to be varied when the transceiver is switched from transmit to receive or vice versa. To achieve the variation in resonant frequency a tuning circuit 16 comprising inductive and/or capacitive reactance is switched into or out of circuit as the transceiver is switched between the transmit and receive modes. This may be achieved by passing d.c. control signals over the cable 15.

Figure 6 shows one form the tuning circuit 16 may take. A terminal 17, which in operation is connected to the centre conductor of the cable 15, is connected to one end of a resistor R1 which is connected in parallel with the series arrangement of a capacitor C1 and diode D1. The junction of capacitor C1 and diode D1 is connected through an inductor L1 to a terminal 18 which is connected to the outer conductor of cable 15 and a series arrangement of an inductor L2 and a capacitor C2 is connected across the diode D1. The common point of R1, C1 and D1 is connected to a terminal 19.

In operation, when the transceiver is switched to the transmit mode a bias voltage is applied across cable 15 to terminals 17 and 18 of the tuning circuit 16 with terminal 17 being positive. This causes diode D1 to be forward biassed through resistor R1 and inductor L1 and consequently to short circuit the series arrangement of inductor L2 and capacitor C2. Thus the resonant frequency of the aerial system is dependent mainly on the length of conductor 4. When the transceiver is switched to the receive mode the bias voltage is cut off and thus the diode D1 is no longer forward biassed and consequently has a high impedance. This causes the series arrangement of inductor L2 and capacitor C2 to be connected in series with conductor 4 of the aerial system thus loading the aerial and changing its resonant frequency. The receive frequency may be above or below the transmit frequency depending on the values chosen for inductor L2 and capacitor C2.

While the invention has been described in relation to a bodyworn transceiver it can be applied to other radio apparatus such as simple radio transmitters or receivers or paging receivers.

Claims

1. An aerial system for bodyworn radio apparatus comprising a harness for carrying the radio apparatus, a first conductor attached to or incorporated in a strap of the harness arranged to pass over the shoulder of the wearer, a second conductor suspended from the harness or the radio apparatus, and means for connecting one end of each of the conductors to an aerial input of the radio apparatus characterised in that the second conductor is connected to the live side of the aerial input and the first conductor is connected to the earthy side of the aerial input.

2. An aerial system as claimed in Claim 1 in which the second conductor has an electrical length substantially equal to a quarter of the wavelength of the signal to which the apparatus is tuned.

3. An aerial system as claimed in Claims 1 or 2 in which the second conductor is helically wound.

4. An aerial system as claimed in Claims 1, 2 or 3 comprising means for varying the resonant frequency of the aerial system.

5. An aerial system as claimed in Claim 4 in

which the means for varying the resonant frequency comprises means for inserting a capacitive or inductive reactance between the second conductor and the aerial input of the radio apparatus.

6. An aerial system as claimed in Claim 5 comprising means for switching the inductive or capacitive reactance into or out of the aerial system, the switching being dependent on whether the apparatus is receiving or transmitting radio signals.

7. An aerial system as claimed in Claim 6 in which the switching means comprises means for generating a direct voltage and applying it via a transmission line from the radio apparatus to the means for inserting the reactance.

8. An aerial system as claimed in Claim 7 in which the radio apparatus and holster are provided with a co-operating plug and socket assembly to enable connection between the radio apparatus and the aerial.

9. An aerial system for bodyworn radio apparatus substantially as described herein with reference to Figure 1; Figures 1 and 2; Figures 1 to 3; Figures 1 to 3, 5 and 6; or to Figures 1 to 4 of the accompanying drawings.

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